

widening and average intensity as is found by Mr. Evershed (*Memoirs R.A.S.* Appendix II. vol. liv. 1901, p. [91]) between intensity in the "flash" spectrum and intensity in the solar spectrum. Vanadium and titanium are also elements the lines of which are strong in the flash but comparatively weak in the solar spectrum, and the lines of these elements are also, as has been stated before (*Monthly Notices, R.A.S.* vol. li. No. 2, December 1890, p. 77, and vol. lviii. No. 7, May 1898), very much widened in all spots whether of the maximum or minimum epoch. It would seem to follow that the level of Sun-spots is the level of the upper more extensively diffused portion of the stratum of gas which gives the flash spectrum in eclipses. The following is a summary of the chief results which follow from the detailed study of this Sun-spot group :—

1. That the disturbed area of the solar corona of 1901 May 18 marked the time of the actual outburst of the spots.
2. The outburst occurred in a region which had been disturbed for at least a whole rotation of the Sun before the birth of the spots.
3. That in this case of the only great Sun-spot of an otherwise absolutely quiet year there is no connection between the solar storm and magnetic disturbances.
4. That the most widened lines in the spectra of Sun-spots in the red end of the spectrum are always faint lines, chiefly due to vanadium and titanium.
5. That the level of Sun-spots is the level of the upper more diffused gases which give the flash spectrum in total eclipses.

Stonyhurst College Observatory :
1902 May 4.

The Spectrum of Nova Persei 1901 on and after September 5.
By the Rev. Walter Sidgreaves, S.J.

A reproduction of the spectrum of the Nova, as photographed at Stonyhurst on August 27 and September 5, is given at p. 150 of the December number of the *Monthly Notices*. Since then forty-one photographs have been taken on twenty-eight nights, distributed as in the following list ; in which the letters written after the dates have the same significations as in the wave-length tables of the paper referred to : viz. H the Hilger compound prism on the Perry-memorial Equatorial, and T the Thorp objective prism on the 4-inch finder :

- September 6, H ; 11, T ; 14, H, T ; 15, H, T ; 24, H.
 October 4, H, T ; 6, H, T ; 18, H ; 19, H, T ; 31, T.
 November 1, H ; 2, T ; 14, T ; 22, H, T ; 23, H, T ;
 28, H, T.
 December 5, T ; 14, H, T ; 18, T ; 20, H, T.

January 14, H ; 15, H, T ; 28, H ; 29, T ; 30, H, T ; 31, H, T.

February 10, H ; 12, H.

All these plates show the same spectrum in its general features ; the lines remain very broad, and preserve their relative intensities. This stability of the spectrum is shown in Table I. ; in which the figures of the first column are brought forward from the December paper for comparison with those of the later dates. The measured widths of the lines are given under the letter w ; but the relative intensities have been omitted on account of the discrepancy between the relations as shown by the two spectroscopes employed for the complete spectrum.

In the fourth column, for February 10 and 12, the widths of three lines only are quoted. These could be measured without difficulty, but the edges of the rest were found to be too ill-defined. The star was very small, and the trail across the plate was necessarily too slow for satisfactory definition.

TABLE I.

Bright line spectrum of Nova Persei, 1901.

Oct. 4 & 6.		Nov. 22.		Dec. 20.		Feb. 10 & 12.	
λ	w	λ	w	λ	w	λ	w
386.8	2.5	386.8	3.2	386.8	2.6	386.8	3.0
396.8	2.3	396.8	3.0	396.8	2.6	396.9	2.8
410.1 a	2.1	410.2	2.2	410.1	2.6		
434.1	2.3	434.0	2.9	434.0	2.6	434.0	
436.3	3.0	436.4	3.1	436.3	2.8	436.4	
447.1	2.7						
463.9	2.5	436.9	2.8	464.0	3.2	464.2	
468.0	2.1	468.0	1.7	468.0	1.7	468.8	
472.0 b	2.0	472.0	2.1	472.2	2.2	472.1	
486.1	2.7	486.2	3.2	486.2	2.4	486.1	3.2
495.8	3.0	495.7	3.1	495.9	2.5	496.2	
500.7	3.0	500.6	3.1	500.7	3.1	500.7	

Remarks.

a This line was omitted in the December paper as uncertain. It has since then been easily seen and measured.

b In the same December paper the width of this line was quoted 4μ on August 24 and 27. This width covered the whole band, including outside weaker wings. On the later dates of this table only the central stronger part is entered, because there is no decided termination of the violet-side extension. The appearance is rather that of a light background to the two bands 468 and 472, reading from 467 to 474, and too strong to be reckoned as continuous spectrum.

In Tables II. and III. some of the finer details are presented for further comparisons. Here also there is a general close agreement ; but not without exceptions, which seem to be real

changes, although on account of the failing light of the star, they may be only photographic imperfections. These apparent changes are, in Table II., the relative intensities of the lines 469 and 471 in November and December; and in Table III. the reappearance of lines crossing $H\gamma$.

TABLE II.
Brighter lines in region 467-474.

Aug. 27. λ $\mu\mu$	Oct. 6	Nov. 22.	Dec. 20
467.3	467.5	467.3 w	467.5
468.6 c	468.8	469.1 w	468.8 ss
470.0	470.3 w	470.3 ?	? d
471.2 ss	471.3 s	471.2 w	471.3 s
472.7 s	472.9	472.7 w	472.8

Remarks.—ss = very strong. s = strong. w = weak.

c By an error of copy from the original tabulations this line went to the press for the December paper as 468.1 instead of 468.5. The figures in this column are by remeasurements, which have given 470.0 and 472.7 greater than the former measures by 0.2 and 0.3 $\mu\mu$.
d The uncertainty indicated here by the ? is owing to a scratch through the position where the line might be.

TABLE III.
Brighter lines in region 432-438.

	Sept. 5, Oct. 6. λ $\mu\mu$.	Nov. 22. λ $\mu\mu$	Dec. 20. λ $\mu\mu$
$H\gamma$	[	432.7	432.7
		433.6	433.9
		434.4	
436.3	[	435.2	435.0
		435.9	
		436.1	
		436.5	
	[	437.4	437.5 ?

The structure of the bands at 386.8 and 396.9 has remained probably quite constant. This structure was given in the December paper as four bright components. At that time there was some doubt about the fourth component, whether it was divided or not. Subsequently greatly enlarged photographs showed the *five* components of the band at 386.8 on September 5, and of both bands on October 4 and 6, and November 22. Again, on December 18, the five components were very clearly marked on the more refracted band, but the companion band at 396.9 was not strong enough to show more than four bright parts, the fourth being relatively broad and very weak. And, similarly, on the plates of January 30 and 31 of this year only three of the components can be seen in the band 386.8, the less

refracted band being much too weak to show details. All through this series of photographs the more refracted of the two bands has been the stronger, and the stronger components of each have been of shorter wave-lengths.

The band at 495·9 on December 20 contains two sharply defined brighter lines near its edges, at 495·1 and 497·0; and the same marking, near the edges, appears in $H\beta$ and in the band 500·7. The photograph of this date was by a remarkably successful exposure in a very clear sky, and compares well with the photograph of August 27. On a careful re-examination of this plate the same structure has been found in the bands 495·9 and 500·7, but only doubtfully in $H\beta$.

Stonyhurst College Observatory:
1902 May.

Series in the Nebular Spectrum, and in the Bright-Line Spectrum of Nova Persei. By E. F. J. Love, M.A., Assistant Lecturer and Demonstrator of Natural Philosophy in the University of Melbourne.

§ 1. *Introductory.*

Soon after the spectrum of *Nova Persei* had assumed the nebular type, Lockyer* and Sidgreaves† called attention to the abnormal brightness of three of the lines, compared with that of the "chief" nebular line at λ 5007; Sidgreaves further showed that these lines were characterised, in the *Nova* spectrum, by identity of structure, while the other lines present had a very different appearance. The wave-lengths of these lines, as estimated by different observers, group round the values λ 4363, λ 3968 and λ 3869.

It seemed to me likely that three lines so closely resembling each other might belong to a series of the general type investigated by Kayser and Runge; I therefore made the attempt to find one, with the results detailed in this paper.

§ 2. *Deduction of Series, and Comparisons with Nebular Lines.*

Since the identification of the lines above-mentioned with nebular lines seems to be beyond dispute, I preferred to use their wave-lengths as measured in nebular spectra, since these have recently been redetermined with great exactness at the Lick Observatory‡ by Wright, in the course of the observations on

* *Proc. Roy. Soc.* vol. lxix. p. 133; *Monthly Notices*, vol. lxii. App. p. 1.

† *Monthly Notices*, vol. lxii. p. 137.

‡ *Astrophysical Journal*, vol. xiv. p. 267.